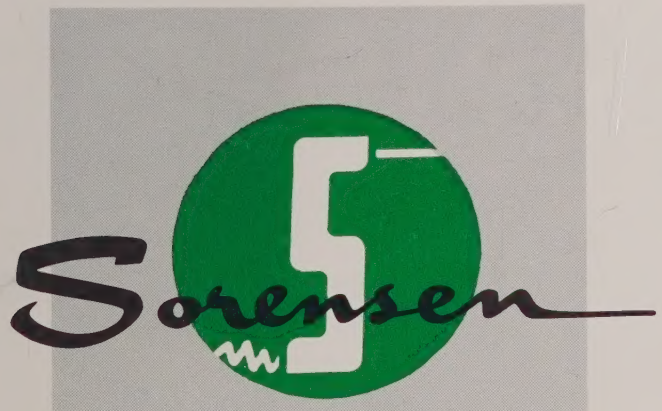
instruction manual

No. 106 A
for
Sorensen "A" Nobatrons



SORENSEN
A Unit of Raytheon
Richards Avenue, South Norwalk, Connecticut

GENERAL INFORMATION

PLEASE READ THIS MANUAL. We think it will help you to obtain the maximum performance from your new Sorensen instrument.

SHIPPING DAMAGE

Sometimes instruments are damaged in transit. We strongly suggest that you inspect and test your instrument as soon as you receive it. If the instrument is damaged or if it fails to operate properly, you should ask the carrier to inspect the shipment. The carrier's claim agent will prepare a report of damage which you should send to us. We will then tell you how to have the instrument repaired or replaced.

SERVICE INFORMATION

If you have any questions about the operation, repair, or servicing of a Sorensen instrument, please contact our local representatives. (A list of representatives appears at the rear of this manual.) If it is more convenient you may contact us directly at the Service Department, Sorensen, Richards Avenue, South Norwalk, Connecticut.

IMPORTANT

BE SURE TO INCLUDE THE MODEL & SERIAL NUMBER IN ALL CORRESPONDENCE CONCERNING THIS INSTRUMENT. WITHOUT THIS INFORMATION WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

RETURNS TO THE FACTORY

Should you decide to return an instrument to us for repair, please contact us for authorization to make shipment. We have a number of local service facilities in the United States and Canada which are equipped and staffed to provide you with fast, efficient service. For this reason, we reserve the right to refuse unauthorized shipments to our plant.

WARRANTY

This instrument is warranted by Sorensen/Unit of Raytheon, to be free from defects in material and workmanship. Our obligation under the warranty is limited to servicing the instrument and replacing defective parts* when the instrument is returned to the factory with transportation charges prepaid. No other warranties may be implied. The period of warranty is one year after the delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, accidents, misuse, negligence, and the alteration or removal of the nameplate, will void the warranty.

*With the exception of tubes and fuses.

NO. 106A

INSTRUCTION MANUAL

SORENSEN "A" NOBATRONS

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SORENSEN

A Unit of Raytheon

Richards Avenue, South Norwalk, Connecticut

I. GENERAL INFORMATION

Before you begin to use your new Sorensen instrument we suggest that you read this Instruction Manual very carefully. The information contained herein is designed to help you obtain the maximum in performance and many years of dependable service from your instrument.

Shipping Damage

The instrument should be inspected and tested immediately upon arrival. In the event the unit fails to operate properly or is damaged in any way the carrier should be notified at once. When the claim agent has inspected the shipment and prepared a report of damage a copy of this report should be sent to us. At that time we will advise you concerning the repair or replacement of the instrument.

Service and Information

All questions concerning the operation or malfunctioning of this instrument should be directed to the Service Department, Sorensen & Company, Inc., 375 Fairfield Avenue, Stamford, Conn.

IMPORTANT

BE SURE TO INCLUDE THE **MODEL** AND **SERIAL** NUMBERS IN ALL CORRESPONDENCE CONCERNING THIS INSTRUMENT. WITHOUT THIS INFORMATION WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

IN THE EVENT OF DIFFICULTY

Should you receive a defective or damaged instrument or require service on an instrument within or outside of warranty, please write us. Be sure to include as much information as possible concerning the symptoms of difficulty, the application, input line voltage, etc. The more information you give us the faster we can handle your request.

In each case we will decide whether the instrument requiring service will be (a) returned to the factory, (b) shipped to a service station, or (c) serviced at your plant by one of our field engineers or representatives.

If the instrument should be returned to the factory we will send you shipping instructions in the form of a Returned Material Tag. DO NOT SHIP A UNIT TO THE FACTORY WITHOUT THIS TAG.

Shipments

All shipments to Sorensen should be prepaid unless we authorize to the contrary. The instrument should be wrapped in heavy paper and packed in the original container or a wooden box with at least three inches of shock absorbent material on all sides.

Warranty

This instrument is warranted by Sorensen & Company, Inc., to be free from defects in material and workmanship. Our obligation to the original purchaser under the warranty is limited to servicing the instrument and replacing defective parts (with the exception of tubes* and fuses) when the instrument is returned to the factory with transportation charges prepaid. No other warranties may be implied.

The period of warranty is one year after the date of delivery of the instrument to the original purchaser.

Uninstructed attempts at repairs, defects caused by improper operating conditions, accidents, misuse or negligence and the alteration or removal of the nameplate will void the warranty.

*Thermosen tubes in Sorensen equipment are guaranteed for 5000 hours or one year, whichever expires first.

General Description

The A Nobatron is a low voltage high current regulated DC supply manufactured by Sorensen & Co., Inc.

Any Nobatron can be readly identified as to its rating by referring to the model number on the nameplate. The first number in the model designation indicates voltage and the final number current. For example, the E-12-50 is a 12 volt unit having a capacity of 50 amperes.

Most Nobatron models are designed for relay rack or cabinet mounting but a few large capacity models are self contained and mounted on casters for floor operation. Complete details are given in the following specifications.

II. SPECIFICATIONS

Following are the basic general specifications applicable to all Sorensen A Nobatrons. More specific details on electrical specifications will be found in Table I and on mechanical specifications including controls in Table II; in addition, input currents and weights of all units are tabulated in Table III.

Electrical Specifications

(See also Table I)

Input Voltage — 95 to 130 volts AC single phase (except models E-28-70 and E-28-150)

Input Frequency — 50 to 60 cycles (except DE models)

Output Voltage Adjustment — +10%, −20% (except 6V models, SWR5 and E-200-5)

Regulation Accuracy — ±.2% against line changes from 105 - 125 volts at any fixed load current (±.25% on DE models) from 1/10 load current to full current

±.2% against load changes from 1/10 load current to full load current (±.25% on DE models) at any fixed line from 105 - 125 volts

±.5% against line changes from 105 - 125 volts at any fixed load from no load to 1/10 load (except on DE models)

±.5% against load changes from no load current to 1/10 load current at any fixed line from 105-125 (except on DE models)

The above regulation accuracy applies only within an output voltage range of ±10% of nominal output. Also note that it holds only within an input voltage range of 105 to 125 volts.

While regulation is possible over the input range of 95 - 130 volts the accuracy figure outside of 105 - 125 volts is greater than ±.2%.

Input voltage range is affected by output voltage setting and load current. Low output voltage settings below −10% of the nominal output rating will shift the input voltage range downward so that the range may be 95 to 115 instead of 105 to 125.

Similarly, high output voltage settings will shift the input range upward; however, Nobatrons should not be operated above 130 volts input and the units should not be set above +10% of the nominal output without factory approval. These precautions are suggested in order that the voltage ratings of circuit components will not be exceeded. Input voltage range is shifted down by removing load. Conversely, adding load tends to shift the input voltage range upward.

Note that the regulation accuracy applies to line and load separately so that if line and load are both changed the total regulation accuracy becomes ±.4%. The changes against both line and load are as a rule uniform so that if the voltage is set at 115 volts input with half load, the maximum change for line would be .2% up at 125 volts half load and .2% down at 105 volts half load. Due to the nature of the load compensating circuit the change with load may be in either direction, up or down .2% to full load and down or up .2% to 1/10 load.

Input Frequency Changes — The regulation accuracy of ±.2% for changes of line or load apply at 50 or 60 cycles. If the frequency is varying the regulation accuracy will deviate more than ±.2% until the frequency becomes fixed. Frequency also affects the input voltage range. A lower frequency will shift the input voltage range downward.

Ripple — 1% R.M.S. maximum at 60 cycles (360-440 cycles on DE models) 2% R.M.S. maximum at 50 cycles. Ripple specifications will be met at full load over the rated input

voltage range and over ±10% output voltage adjustment at normal room temperature. Ripple decreases as load current decreases. Also, percentage of ripple increases as the output voltage is decreased. Below —10% of nominal output voltage setting the ripple may be more than 1%. Below 15°C (59°F) ripple will increase and may be above 1%. At low temperatures the high initial ripple will be decreased as the unit warms up.

Recovery Time

.20 seconds (except models E-28-70, E-28-150). Recovery time is defined as the time constant of the unit or the time for the output to effect a 63% recovery from the maximum deviated value. Time to return to within ±.2% of the initial value is longer than this and is difficult to measure.

Load transients will cause the output voltage to drop or rise, the amount of change depending on the magnitude and rate of rise of the transient and the amount of capacity across the output of the Nobatron. The Nobatron output voltage will begin to recover in .04 seconds or less. The magnitude of the voltage change may be reduced by adding additional capacitors across the output but this may increase the recovery time above .20 seconds.

Line transients will also be attenuated by the filter condensers as well as by the inductances of the saturable core reactor and the filter choke.

Ambient Temperature Range & Drift

—20°C (—4°F) to +35°C (95°F.) Regulation accuracy of ±.2% cannot be held with changing temperatures.

1% ripple will not be guaranteed below 15°C (59°F). When the Nobatron is operated above 35°C the life of various components will be reduced. In some cases, however, operation at reduced loads is possible at higher ambients.

Below 0°C (32°F) regulation accuracy may be poorer than ±.2% at fixed temperature.

After allowing 30 minutes for warm up, drift should not be more than ±.5%.

If the Nobatron is to be exposed to unusual temperature conditions, we suggest consultation with the factory for information concerning precautionary measures. At such times full details on the application should be forwarded to us.

Miscellaneous Specifications

(See Table II)

Type Construction

Most units are made for standard 19" relay rack or cabinet mounting on either one or two chassis. The larger capacity units are floor models on casters. 400 cycle units are self contained for bench top operation only.

Terminals

Input terminal board with ground terminal and output terminal board are provided on most units. Large capacity units have individual terminals in a junction box or on a phenolic board. 400 cycle units usually are equipped with AN connectors.

Controls

An on-off switch is provided in all units. Since in some units this is a single pole switch, AC voltages to ground will exist when the switch is open unless the ungrounded side of grounded system is connected to side of input terminal which goes to the switch. Even with a double pole switch, voltages still exist in the unit up to switch terminals. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

Output voltage is adjusted by means of a screwdriver-adjust potentiometer (units of 48 volts rating and up have knob). Clockwise rotation increases the output voltage.

TABLE I

ELECTRICAL SPECIFICATIONS

MODEL	E-6-5A E-6-15A E-6-40A E-6-100A	E-12-50A *	E-12-5 E-12-15 E-28-5 E-28-10 E-28-30 E-48-15	E-125-10	E-200-5	E-28-70	E-28-150	DE-6-40 DE-12-10 DE-28-10
INPUT VOLTAGE RANGE	95-130	105-125	95 — 130			190-260	95 130 165 225	95-130
FREQUENCY	50-60							360-440
PHASE	1						3, 4-wire	1
OUTPUT VOLTAGE ADJUSTMENT RANGE	6v±10% 7v±10%	9.0—17.6	+10% —20%		±50%	+10% —20%		
OUTPUT CURRENT	For all models see note under "General Description."							

REGULATION ACCURACY AND RANGE OVER WHICH IT APPLIES

INPUT VOLTAGE	105-125					200-240	110 130 190 205	105-125
OUTPUT VOLTAGE	6v±10% 7v±10%	9.0—17.6	±10%		+50% —25%	±10%		
REGULATION ACCURACY	1/10 load to full load ±.2%				No load to full load ±.2%	1/10 load to full load ±.2%		±.25%
REGULATION ACCURACY	No load to 1/10 load ±.5%				———	No load to 1/10 load ±.5%		No load to 1/10 load No Spec.
RIPPLE — TO MINIMUM OUTPUT OF —10%	1% RMS at 60 cycles 2% RMS at 50 cycles							1% RMS 360-440 cycles
RECOVERY TIME	.20 second					.25 sec.	.30 sec.	.20 sec.
AMBIENT TEMPERATURE RANGE	—20°C (—4°F) to 35°C (95°F)							
INPUT CURRENT	See Table III			33	33	35	31	See Table III
TUBE COMPLEMENT	2AS15 5Y3 6L6					2AS15 5R4GY 813		2AS15 5Y3 6L6

*Regulation Accuracy not guaranteed below 10.0 volts except at 60 cycles.

On dual range units, a range adjustment switch is provided. To prevent switching surges, this switch should not be operated unless the Nobatron is turned off. On 6 volt units the output voltage will not increase to 7 volt by operating this switch and the potentiometer must be rotated to increase the output voltage.

Overcurrent Devices

Overcurrent protection is provided in all models by thermal or magnetic breakers. On larger models this is a manual reset device incorporated as part of the on-off switch. In the balance of the models the breaker is an automatic reset thermal device.

Overvoltage Devices

A fuse is provided in the control circuit. If this fuse blows, voltage still exists in power circuit. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

Failure of the tube filaments including the safety diode results in low output voltage. Overvoltage protection by means of magnetic breaker is provided on large capacity (3 phase) models.

A pilot light is provided in the control circuit. Power may still be in power circuit if pilot light is off.

Grounds

For safety reasons it is recommended that the user provide a ground connection from the electrical wiring ground (BX cable or pipe) to the chassis of the Regulator.

All units are shipped with the negative output grounded to chassis. This ground may be placed on positive terminal or removed completely. Ground lead is usually black, or white with a black tracer.

Meters

Meters can be provided on all but the 400 cycle models and are standard on most of the larger capacity models. On all models of 10 amperes or over the diode current of .3 ampere will show on the meter when there is no load on the unit. On 5 ampere units the diode current does not pass through the meter.

Forced Air Cooling

Large three phase units are provided with fan cooling for the selenium rectifier. An air switch is provided on the rectifier to shut unit off if the fan fails.

Time Delay

In all units there is a time delay before full output voltage appears due to warm-up of tube filaments. A low output voltage (depending on the load applied to the unit) appears as soon as switch is turned on.

On high voltage units which use gas tube rectifiers instead of selenium there is an additional thermal time delay (as per Table II) to insure that the tubes are permitted the proper warm-up time.

III. INSTALLATION INSTRUCTIONS

Mounting

To mount the chassis in rack or cabinet it is necessary to remove the front panels to make the mounting slots accessible. Mounting hardware is provided.

Cabinets may be supplied knocked down. In this case assembly instructions will be included with cabinet.

On large floor units, the controller section is shipped separate. The upper front panel must be removed in order to install the controller.

Interconnection

On rack mounted units with two chassis a cable with a plug is provided on the rectifier chassis which goes into the socket on the controller chassis. (On earlier units a separate cable which plugs into both chassis may be provided.)

On floor models a cable and plug are also provided to plug into the controller. The top or side panel should be removed in order to insert the plug although it is possible to insert plug into controller just before controller is put into the frame.

TABLE II

MISCELLANEOUS SPECIFICATIONS

MODEL	E-6-5A E-6-15A E-6-40A SWR5	E-12-5 E-12-15 E-28-5 E-28-10	E-6-100A E-12-50 E-28-30 E-48-15	E-125-10	E-200-5	E-28-70	E-28-150	DE-6-40	DE-12-10 DE-28-10
TYPE CONSTRUCTION	Rack mounting					Floor model		Bench model	
	1 chassis		2 chassis						
DIMENSIONS RACK	19" wide x 12¼" high x 14½" deep		19" wide x 31½" high x 14½" deep			29" W 30¼" H 23¼" D	36" W 42" H 24" D	16" W 7-13/16" H 12½" D	
CABINET	21¾" wide x 14" high x 15" deep		21¾" wide x 36¾" high x 15¼" deep OR 21¾" wide x 33¼" high x 15¼" deep						
WEIGHT	See Table III			200 lbs.	240 lbs.	475 lbs.	500 lbs.	See Table III	
INPUT TERMINALS	Terminal board on lower left		Terminal board on lower left of controller chassis			Junction box on right side	Phenolic board on right of frame inside cover	Line cord	AN connector
OUTPUT TERMINALS	Terminal board on lower right		Terminal board on upper left of power chassis					Binding post	AN connector
ON-OFF SWITCH	D.P.S.T.		*S.P.S.T. Thermal	*S.P.S.T. Magnetic		*S.P.S.T. Thermal	S.P.T.S. & Contactor	D.P.S.T.	
RANGE SWITCH	Yes	None except E-6-100A							
OVERCURRENT PROTECTION	Auto reset thermal		Non-auto *reset thermal	*Non-auto reset magnetic		Non-auto *reset thermal	Auto reset thermal	Auto reset thermal	
METERS	Optional		Standard	Optional		Standard		No provision	
FAN COOLING	No						Yes	No	
FILAMENT TIME DELAY	None			60 sec.	30 sec.	None			

*The same device used as an ON-OFF switch is also used for overcurrent protection

Tubes

Tubes are shipped un-installed in corrugated cardboard. Tube sockets are marked with the tube type that is to be used. If more than one tube has a plate cap, tube and lead are marked to show which cap goes on which tube. INSURE THAT EACH PLATE LEAD IS CONNECTED TO THE PROPER TUBE. Unless top or side or rear panels are removed on floor units, tubes should be inserted before the controller is installed.

•

Rectifier

On some models the metallic rectifiers may be blocked so that they cannot turn in shipment. REMOVE THIS BLOCKING MATERIAL BEFORE OPERATING UNIT. (On other models permanent insulators are used to prevent the rectifier from turning; therefore no blocking material is used.)

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Terminals

On rack mounted units input and output connections are made to terminal boards located behind the removable front panel through grommet holes in the side lips of the chassis. See Table II for location of these terminal boards and for type of terminals available on other units. A ground terminal is available on all units.

The wire size used in connecting a unit should be at least as large as that required to carry the input and output currents listed on nameplate and Table III in accordance with applicable wiring codes covering the installation. It is recommended that even larger wire sizes be used on the output circuit in order to reduce the voltage drops between the terminals and load to a minimum.

Table III

Weight and Input Currents

Model	Net Weight—Lbs.	Input Current—Amps.
E-6-5A	65	2.5
E-6-15A	65	4.5
E-6-40A	90	10
E-6-100A	230	26
E-12-5	70	3.0
E-12-15	75	7.0
E-12-50A	170	23
E-28-5	65	6.0
E-28-10	70	10
E-28-30	180	28
E-28-70	475	35
E-28-150	500	31
E-48-15	230	28
E-125-10	200	33
E-200-5	240	33
DE-6-40	65	10
DE-12-10	55	6.0
DE-28-10	60	10

IV. PRINCIPLE OF OPERATION

The operation of the unit can best be understood by referring to the representative schematic diagram included as part of this manual. In the event exact information is required concerning a specific unit, then reference should be made to the schematic covering that particular model. Such schematics are furnished with each unit.

Most components used are listed as follows although every one may not be used in a particular unit.

R1 — Series limiting resistor in high voltage supply to bridge circuit to limit peak currents in rectifier S1 and condenser C1.

R2 — Antihunt resistor in series with antihunt condenser C2. Not used in many units.

R3, R4, R5 — Bridge resistors.

R6 or R16 — Swamping resistor across DC coil or reactor T3. This limits AC voltage across this coil and limits high peaks on surges. This resistor is sometimes connected to screen of V2, instead of directly across coil but still performs swamping function.

R7 — Screen Divider for V2.

R8 — Compensating Adjustment in cathode circuit of V2 and diode circuit of V1.

R9 — Output voltage adjustment used to center adjustment range.

R10 — Output voltage adjustment potentiometer.

R11 — Load compensating adjustment used in some units to supplement voltage drop of Choke L1 or make adjustment in dual output units.

R12 — Load compensating adjustment.

R13 or R23 or R24 — Bleeder Resistor to provide minimum load on Reactor T3 and discharge condensers C5 and C6.

R14 — Ammeter shunt.

R15 — Antioscillation resistor in grid of V2 (at tube Socket) to prevent oscillation in some units.

R19 — Shunt Resistance on R9 to reduce output adjustment range.

R20 and R21 — Line compensating resistors between B+ and the + side of V1 cathode, R20 is fixed and R21 is adjustable.

C1 — Filter Condenser for bridge high voltage supply.

C2 — Antihunt Condenser.

C3 — Filter Condenser for V2 high voltage supply.

C4 — Tuning Condenser for Reactor T3 to improve light load range. Seldom used.

C5 — Input Filter Condenser. Usually consists of several condensers in parallel.

C6 — Output Filter Condenser. Usually consists of several condensers in parallel.

C7 — Tuning condenser for Choke L1 to reduce ripple. Used on very few units.

C9 — Reduces peak voltages of T3 across DC coil.

S1 — Rectifier for bridge high voltage supply.

S2 — Power Rectifier.

V1 — Sensing Diode.

V2 — Amplifier Tube.

V3 — Rectifier for V2 high voltage supply.

L1 — DC Choke.

T1 — Power Tranformer for amplifier usually including filament windings for V2 and V3 but sometimes carrying high voltage winding for bridge instead.

T2 — Bridge Transformer or Filament Transformer depending on what is not included as part of T1.

T3 — Saturable Core Reactor.

T4 — Auto Transformer.

T5 — Rectifier Input Transformer.

SW1 — On-Off switch including in some units thermal or magnetic overload coils.

SW2 — Thermal or magnetic circuit breaker.

SW3 — Range Switch.

F1 — Control Circuit Fuse.

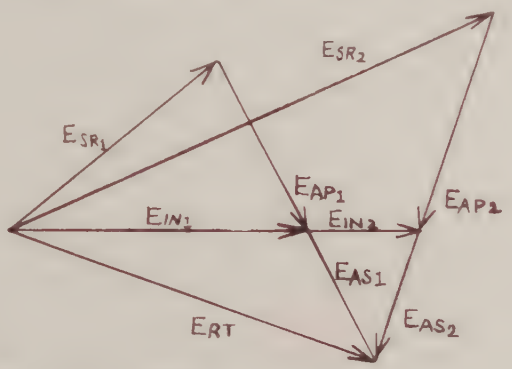
PL1 — Control Circuit Pilot Light.

A — Ammeter.

V — Voltmeter.

The Nobatron consists of a power circuit divided into AC and DC portions and an electronic control circuit. The AC portion of the power circuit consists of a reactor T3 in series with the primary of the auto transformer T4 across the input, with the rectifier transformer primary connected across the auto transformer and reactor. Operation of this circuit can be understood best by study of vector diagram shown in simplified form for two values of input voltage. (Actually there will be a slight change in the phase angle of the output voltage.)

When the input voltage is reduced the reactor voltage and hence reactor impedance must be reduced to hold the voltage constant to the rectifier input tranformer. Also, when the load current is changed, the reactor impedance must be changed to hold the DC output constant, and in this case the rectifier input transformer voltage will change due to the regulation of the rectifier circuit.



EIN = input voltage
ERT = rectifier transformer primary voltage
ESR = saturable core reactor voltage
EAP = auto transformer primary voltage
EAS = auto transformer secondary voltage

Vector diagram shows conditions at nominal output, half load at low input (subscript 1) and high input (subscript 2).

The DC portion of power circuit consists of rectifier S2 (or tubes V4 and V5) and filter circuit C5, L1 and C6.

The impedance of the reactor is controlled by the current in the DC coil, increased current reducing the impedance and vice versa. This current is controlled by amplifier tube V2 whose grid is controlled by the output of a bridge consisting of diode V1 and resistors R3, R4 and R5.

The diode is operated at a temperature limited condition so that a small change in diode filament voltage results in a change of cathode emission and a large change of plate resistance. This change in plate resistance changes the unbalance of the bridge and hence the grid voltage on V2.

The diode filament operates at 1.8 volts and is operated off the DC output voltage thru series dropping resistors R9 and R10. Resistance required is 3 ohms per volt.

The gain of the amplifier is insufficient to give rated regulation accuracy without additional circuitry due to the fact that B+ supply for amplifier is supplied from the input line. In most units the resistor R8 common to cathode circuit of V2 and filament circuit of V1 is used to compensate for this. When the input voltage is reduced, increased current is required in the DC coil of the reactor. This current going through R8 reduces the filament voltage of V1 thereby increasing the error signal from the bridge by an amount enough to overcome the lack of gain of the system.

Load current changes also change the plate current of V2 and through R8 cause too large an error signal thus making the output voltage increase with increasing load. This is corrected by the load compensating circuit which introduces a voltage drop between the output terminals and point where the sensing leads are connected. This is done by the series resistor R11 and/or potentiometer R12 across choke L1.

R8 and R12 are both in the diode filament circuit and contribute along with R9 and R10 to the voltage drop between the output voltage and the diode filament.

In some cases line compensation is accomplished by applying B+ voltage through resistors R20 and R21 directly to the diode filament. This eliminates the need of load compensation by R11 and R12 but in some cases R8 must then be used for load compensation.

In some cases R20 and R21 are used for partial line compensation with remainder supplied by R8. R11 or R12 must then be used for load compensation.

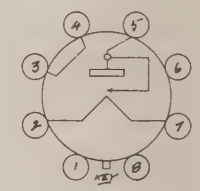
V. MAINTENANCE AND TROUBLE SHOOTING

During normal life this instrument requires no maintenance other than the care afforded similar electronic equipment. Tubes should be replaced at the end of their specified life in accordance with the policies established for the particular application. Since the life of rectifier stacks can be considerably reduced by restricting the air flow over the plates it is suggested that excessive dust, etc., be removed periodically. At such time care should be exercised to prevent damage to the plates by cleaning tools or excessively strong air blasts.

2AS15A Tube Data

In almost all cases it will be found that if the 2AS15 filament is intact the tube is good; however, for those customers who wish to set up special tests the following data is included:

Filament	1.8 volts DC/AC
	310 - 335 ma.
Plate	500 volts DC
	.410 - .600 ma. DC



Spare Parts

All components in a Nobatron are of a good commercial grade and can be expected to give a reasonably long period of trouble-free service. As the age of the instrument increases, however, some components are likely to deteriorate; we therefore suggest that the customer contact our Service Department for a list of the parts that should be kept on hand.

In the event it becomes necessary to replace any part we strongly suggest that the replacement parts be of the same value as the original. Substitute parts should not be used unless we advise that the substitute part will not impair the performance of the instrument.

CAUTION

DANGEROUS VOLTAGES EXIST IN THIS INSTRUMENT. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

TROUBLE SHOOTING

Typical circuit voltages are indicated on the appropriate schematic drawing supplied with each unit. (Note the representative drawing elsewhere in this Manual.) All voltage measurements should be taken with 1000 ohms/volt voltmeter except grid voltages which should be measured with an electronic type voltmeter.

THE FIRST STEP IN TROUBLE SHOOTING SHOULD BE TO REPLACE EACH TUBE WITH ONE KNOWN TO BE GOOD. IN MANY CASES THIS WILL BE ENOUGH TO CORRECT THE DIFFICULTY.

Symptom A—High Output Voltage

Possible Cause:	Check:
	Isolate difficulty by removing V2 from its socket. If the output voltage drops the trouble is in the control circuit or the diode sensing circuit.
Open Diode Sensing Circuit (o--o--o--o--) see schematic	Determine if the diode sensing circuit is open at any point.
Shorted Elements in Tube V2	Replace tube with one known to be good.
Improper Circuit Voltages	Test the circuit voltages at points where the voltages are indicated on the schematic. If abnormal voltages exist (more than 20% deviation) check the contacts, connections and resistance values of all associated components.

Symptom B—No Output Voltage

Possible Cause:	Check:
An Open in the Power Circuit (-- -- -- -- -- --) see schematic	Test for an open circuit in one of the following components: on-off switch, circuit breaker, AC windings of T3, primary and secondary of T4, and primary and secondary of T5. The rectifier stack and filter circuit following may be checked by disconnecting the AC line from the primary of T5 removing V1 and V2 and applying line voltage directly to the T5 primary with ½ load on the output. This should give approximately the nominal output voltage.
Faulty Over-Voltage Circuit Breaker	If a series resistor is used it may be readjusted; otherwise, the breaker must be replaced.

Symptom C—Low Output Voltage

This condition indicates the failure of control circuit to supply sufficient saturating current through T3.

Possible Cause:	Check:
	Test continuity of fuse; replace only with fuse of similar value.
Tube Failure	Replace with tubes known to be good.
Open DC Coil on T3	Open one lead and check for continuity.
Improper Circuit Voltages	Test the circuit voltages at points where the voltages are indicated on the schematic. If abnormal voltages exist (more than 20% deviation) check the contacts, connections and resistance values of all the associated components.

Symptom D—Drift with Age of the Range of Output Voltage

This condition indicates a variation of tube characteristics with age.

Check:

Replace tubes with spares known to be good.

Symptom E—Reduction of Regulation Range or Poor Regulation in General

These conditions may be the result of deterioration or failure of various components of the control circuit.

Check:

1. Test tubes or replace with spares.

2. Test the DC power supply voltages.

(Continued on page 14)

TABLE IV.

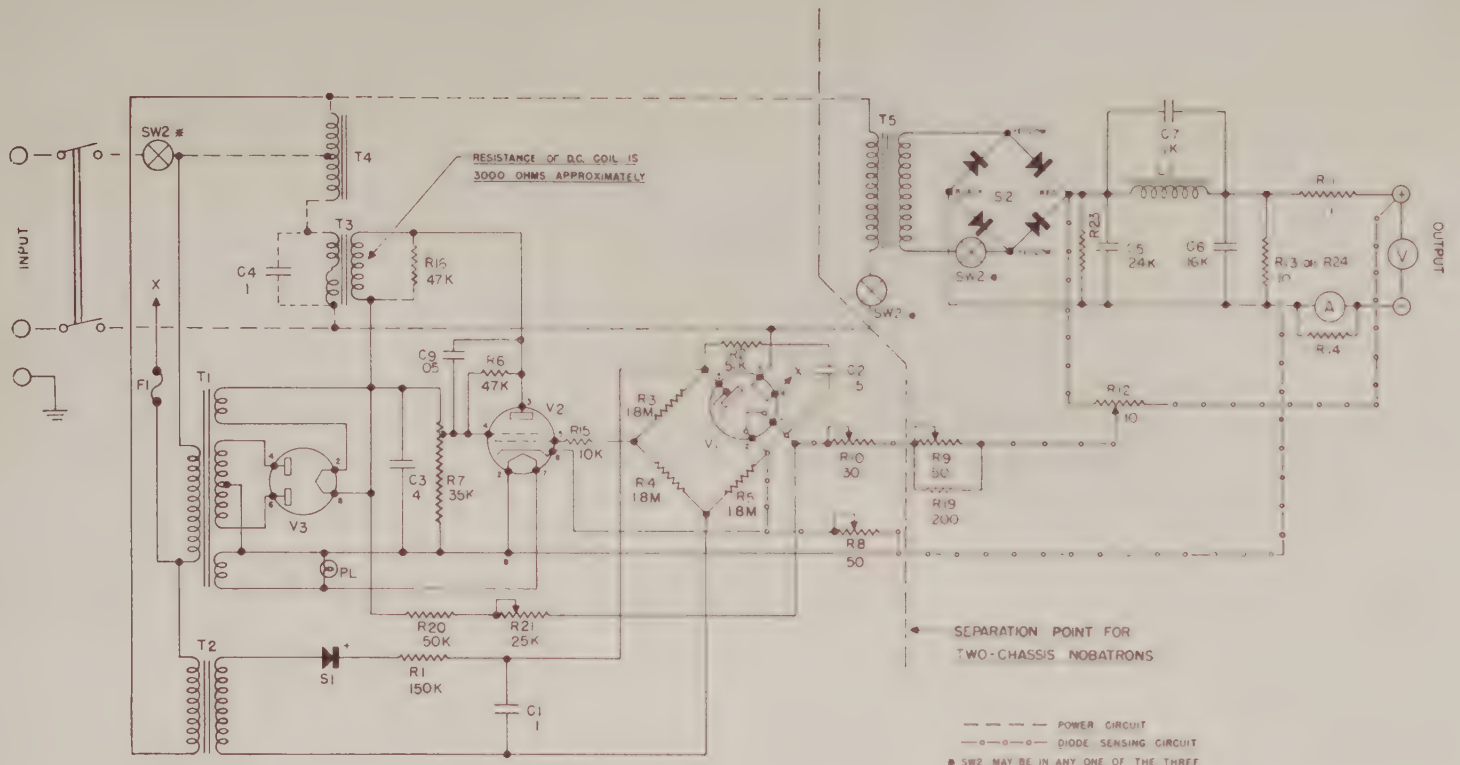
VOLTAGE MEASUREMENTS

Because the voltages noted on the schematic drawings furnished seperately with the manual were taken under fixed conditions of input, output, and load, it may not be realized that under other conditions there will be some variations in the voltages existing at any given point. Below is a set of voltages recorded from a Model E-28-10 regulator and while these voltages may not apply precisely to other models, the degree of variation is approximately the same.

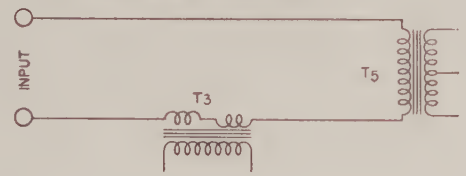
	ZERO LOAD			HALF LOAD			FULL LOAD		
	95 Volts Input	115 Volts Input	130 Volts Input	95 Volts Input	115 Volts Input	130 Volts Input	95 Volts Input	115 Volts Input	130 Volts Input
V2 PLATE E	355	460	520	265	385	455	205	305	390
V2 GRID 1 E	−26	−39	−51	−9	−23	−31	0	−8	−18
V2 GRID 2 E	280	335	390	240	305	355	195	255	315
B+	380	480	530	345	435	510	315	410	490
Bridge + E	195	185	175	240	230	220	255	250	245
Bridge − E	−240	−260	−280	−245	−285	−290	−275	−285	−295
*AC VOLTS ACROSS DC COILS OF T3	92	135	165	100	140	170	92	135	170
T4 Py E	30	42	56	48	59	70	60	69	79
T4 Sy E	22	32	41	36	42	52	42	48	58
T5 Py E	107	110	112	123	126	128	134	136	138
T5 Sy E	26	27	28	30.5	30.5	32	32.5	33	33.5

* Use series capacitor to block DC potential.

SD 200-1038



ALTERNATE A.C. POWER CIRCUIT



— — — — POWER CIRCUIT

—o—o—o— DIODE SENSING CIRCUIT

* SW2 MAY BE IN ANY ONE OF THE THREE POSITIONS SHOWN

NOTE: THIS DIAGRAM IS SUPPLIED TO FACILITATE TROUBLE SHOOTING. HOWEVER, SINCE EACH MODEL WILL HAVE MINOR VARIATIONS IN CIRCUITRY AND DIFFERENT COMPONENT VALUES, REFERENCE SHOULD BE MADE TO THE SCHEMATIC MARKED WITH THE MODEL AND SERIAL NUMBER OF THE SPECIFIC NOBATRON

K = 1000

M = 1,000,000

CAPACITANCE VALUES IN MFD

REVISED 12-21-55

SORENSEN & CO., INC.
STAMFORD, CONN

REPRESENTATIVE "A"
NOBATRON CIRCUIT DIAGRAM

DRAWN 8-5-54 JG APPROV 8-5-54

SD 200-1038

(Continued from page 11)

3. Test the control circuit in general for loose connections, shorts, or damaged parts.

4. Test voltage and resistance values. Check condensers by replacement.

5. The output voltage adjustable potentiometer may cause irregular output adjustment. Turn the potentiometer shaft several times in both directions as far as it will go. This is a very low resistance adjustment and contacts can oxidize enough to cause uneven control.

6. Test output ripple. If this is high, test condensers C5 and C6 and choke L1.

IN THE EVENT OF SERIOUS DIFFICULTY OR DAMAGE TO THE NOBATRON WE SUGGEST THAT CONSIDERATION BE GIVEN TO RETURNING IT TO THE FACTORY FOR REPAIR.

Compensating Procedure

Definition of compensating: Compensation means a reduction of the amount of voltage deviations caused by line or load changes.

The Nobatron has several components that are factory adjusted to the optimum value and readjustment in the field is not recommended; however, a brief description of the procedure is given to be used in an emergency.

Adjustable resistor R8 in the cathode circuit of V2 and filament circuit V1 is used for line compensation. With this resistor value too low increasing the input voltage will increase the output voltage. Increasing value of R8 will make the output voltage constant with varying line voltage and making the value too large will cause the output voltage to decrease with increasing line voltage. Under full load conditions decreasing the line voltage below 100 volts will sometimes cause the output voltage to increase when R8 is at proper value due to the non linearity of V2 plate current change.

When the Nobatron is compensated for line the output voltage rises with increasing load at the point where the sensing leads are connected. This is compensated for by introducing a voltage drop between the output terminals and this point. This is done by a resistor R11 in the plus output lead or by using part of the voltage drop across the DC choke L1 by means of the potentiometer R12. If the output voltage rises with increasing load the value of R11 should be increased on the slider or R12 should be moved to the left.

Line compensating should be done first as the setting of R8 affects the setting of R12 or R11.

Another adjustment involves the resistor designated R9. Adjustment of the resistor may be necessary when a new diode is installed and the voltage adjustment potentiometer does not permit setting the output voltage between specified values.

Filter Capacitors

In the event one or more input filter capacitors (C5) fail they should be replaced at once or else the load on the Nobatron should be reduced in proportion to the amount of capacity removed. If this precaution is not observed premature failure of the remaining input capacitors may result.

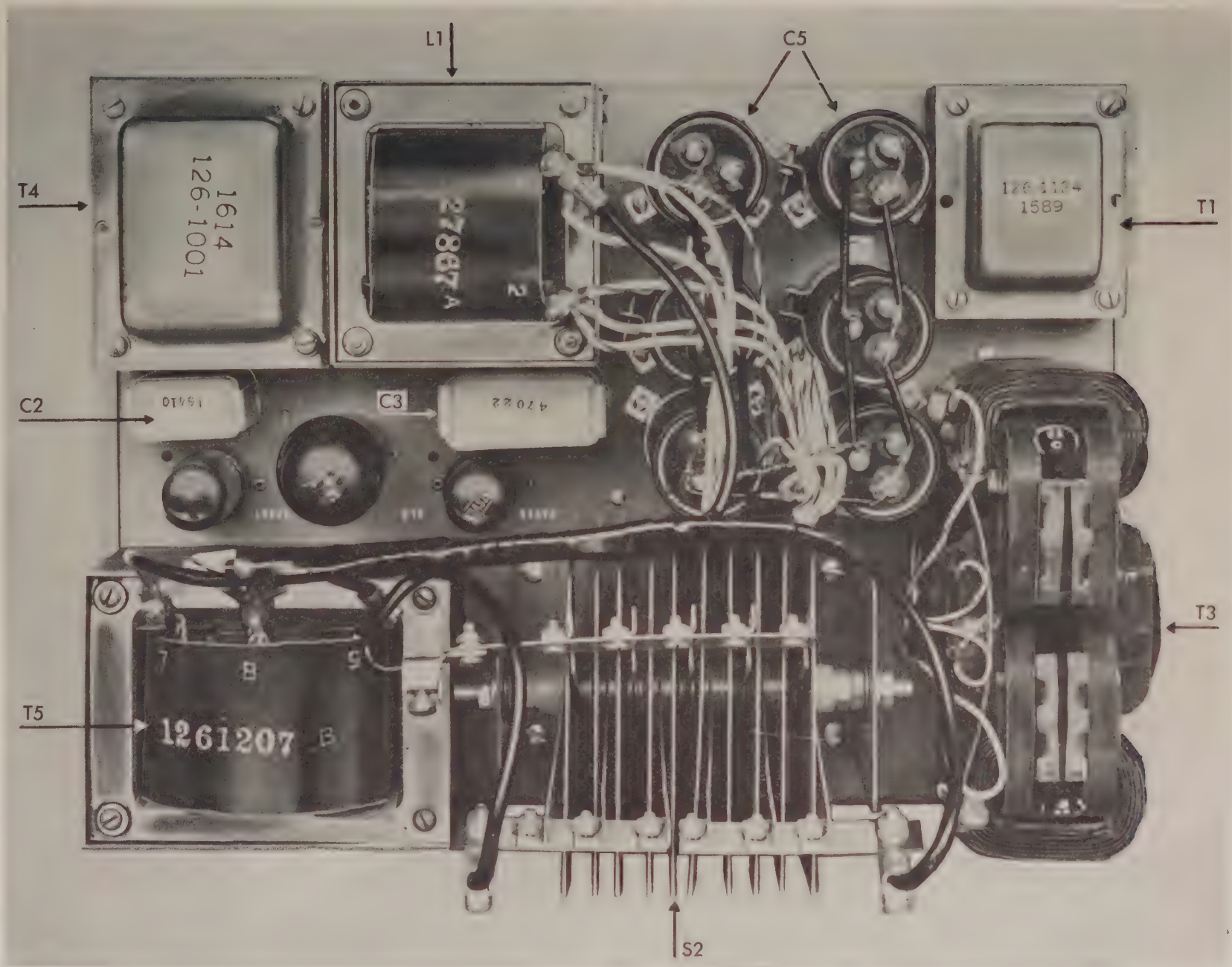
Illustrations

Top and bottom views of the chassis of various models appear on the following pages. These views illustrate the likely location of the various components; however, due to the minor changes that will occur from time to time the exact location of every component cannot be predicted. (Each model is undergoing continuous redesign in an effort to better its performance, increase its reliability and permit easier fabrication.)

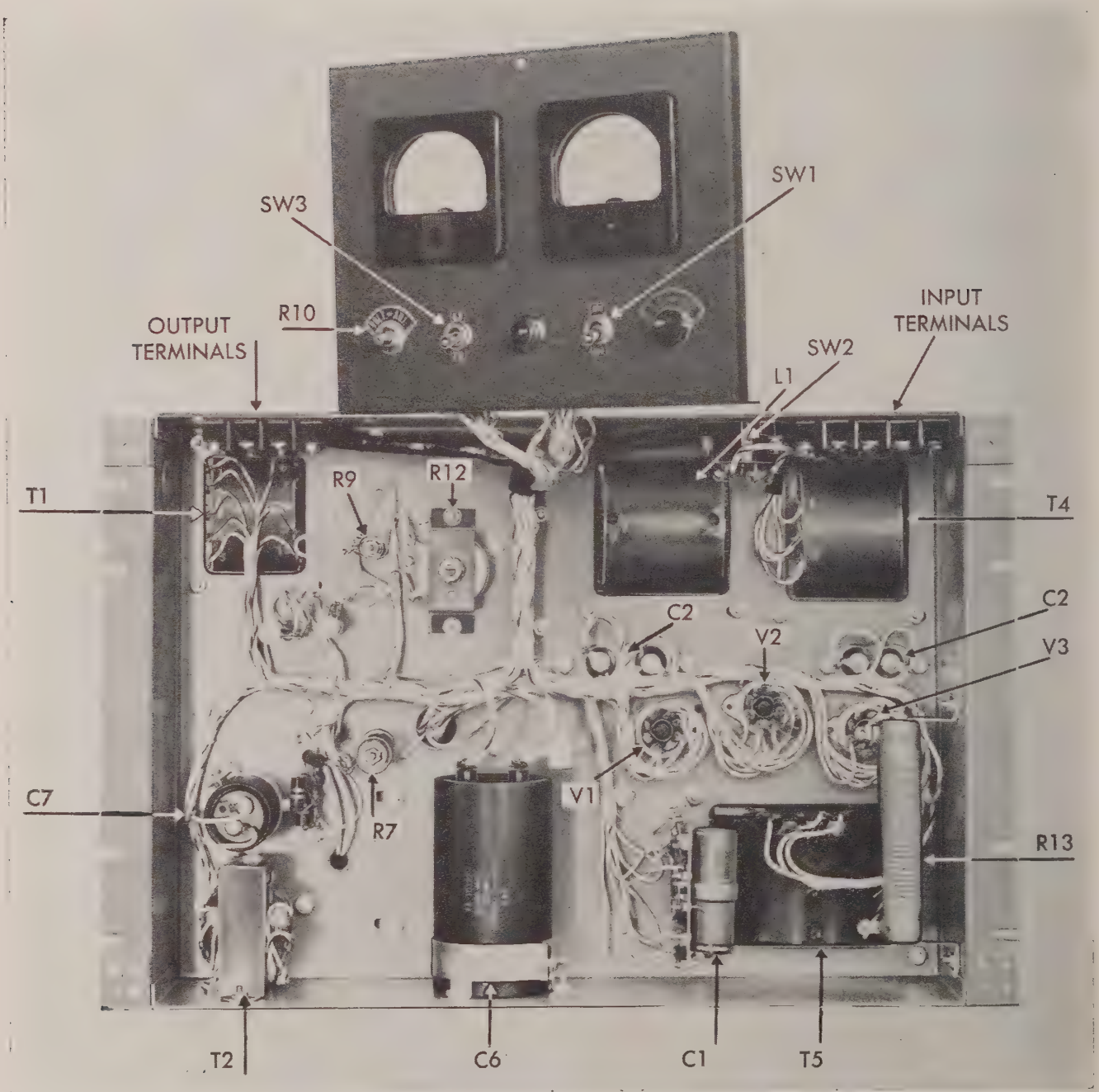
Some model groups are very similar in appearance, therefore, each of the following views can be applied to more than one model.

Model Illustrated	Similar Models
E-6-40A	SWR-5, E-6-5A, E-6-15A, E-28-10
E-6-100A (Power Section)	E-12-50
E-48-15 " "	E-28-30
E-125-10 " "	E-200-5

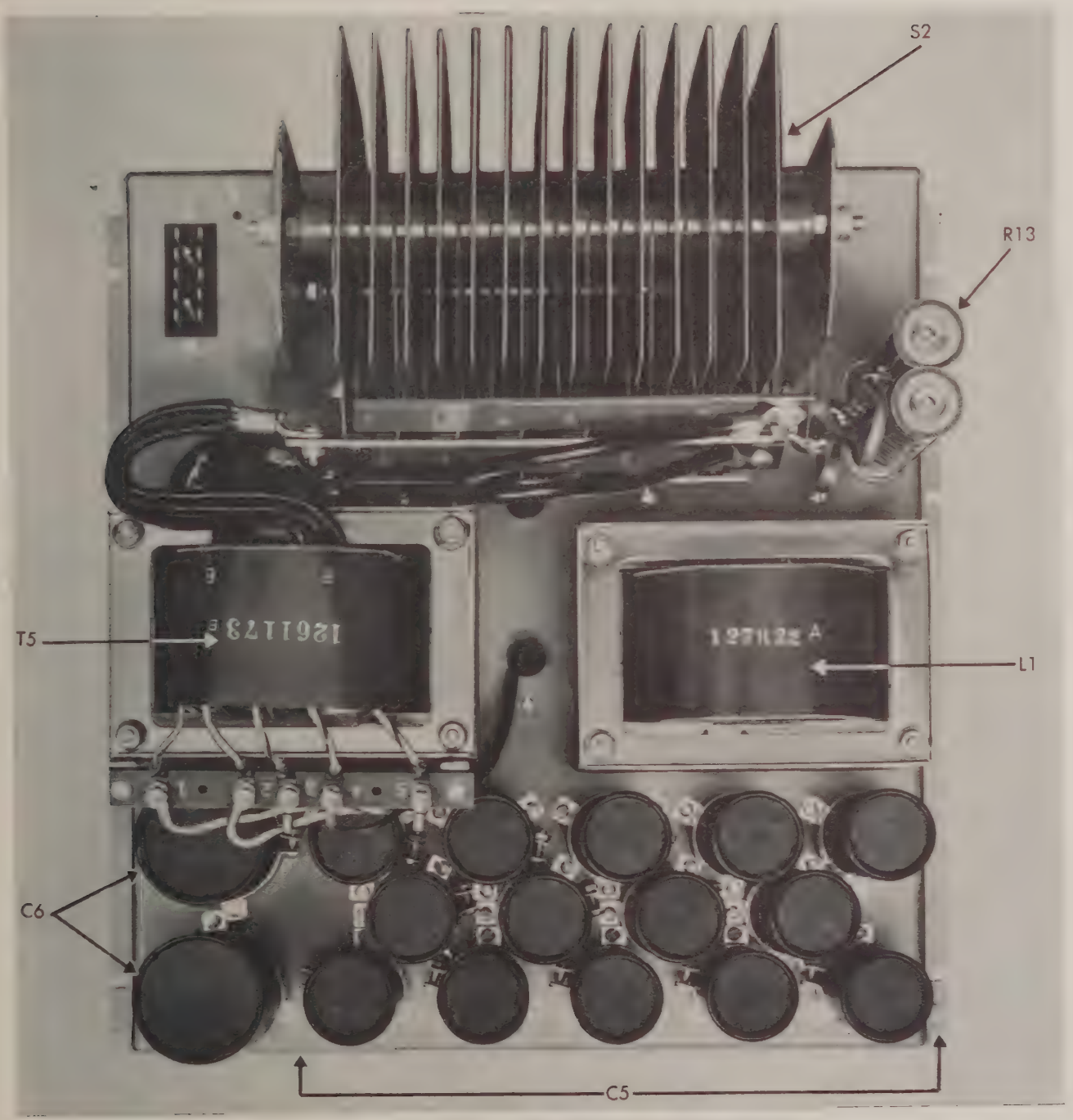
The 2KVA controller is almost identical on the models E-6-100A, E-12-50, E-28-30, E-48-15, E-125-10 and E-200-5.



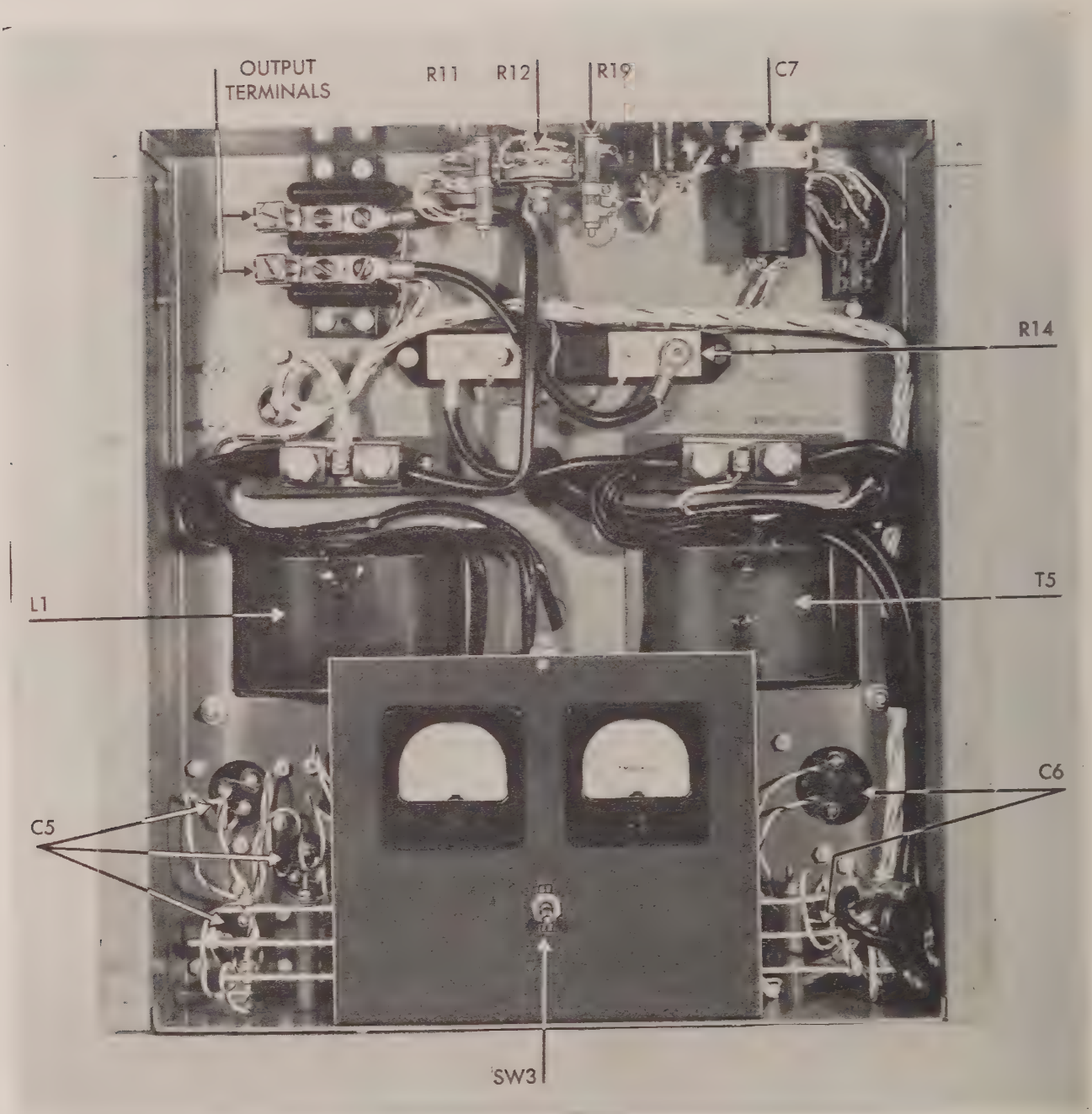
E-6-40A at Serial NG-1219 (Top View)



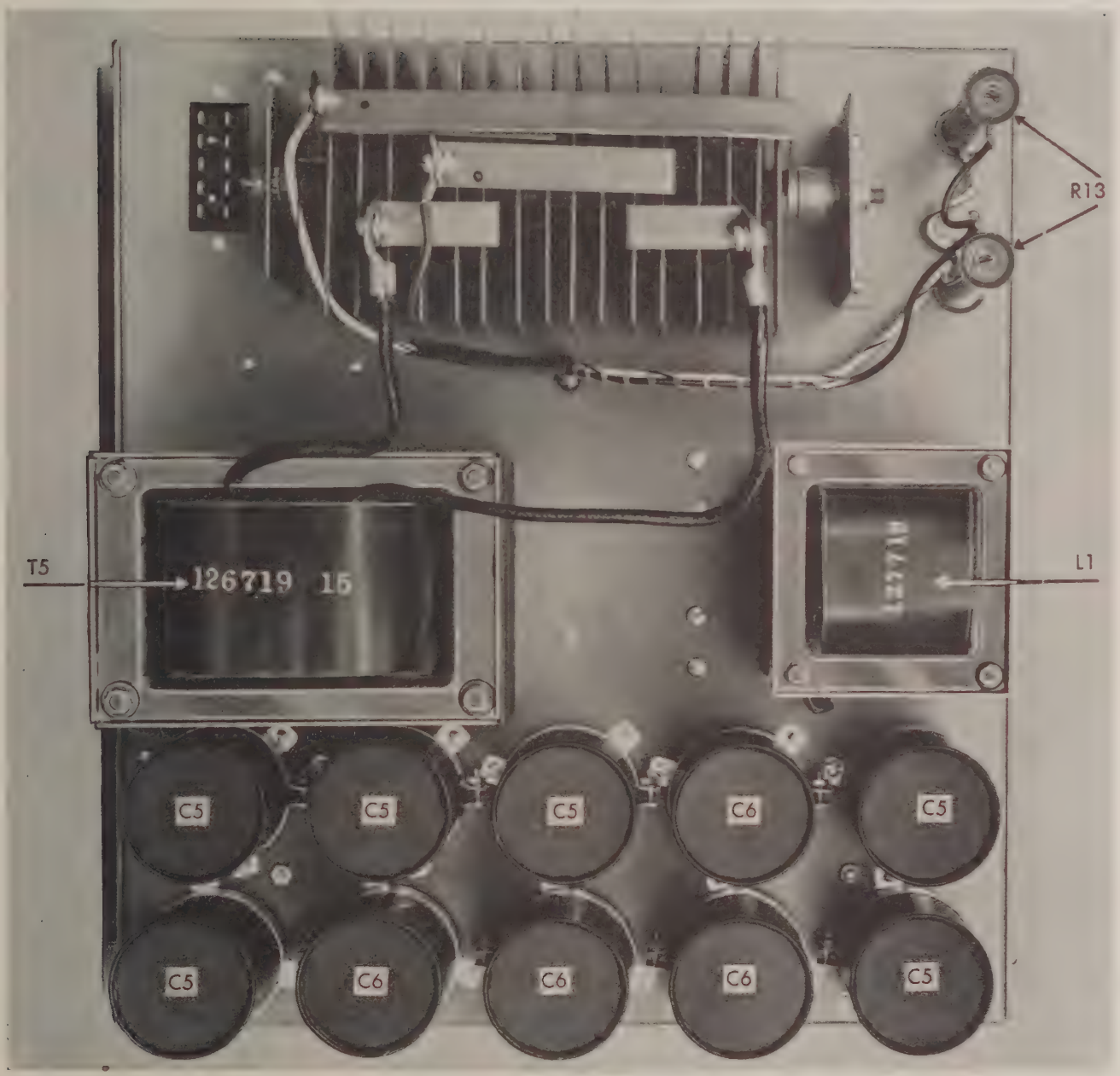
E-6-40A at Serial NG-1219 (Bottom View)



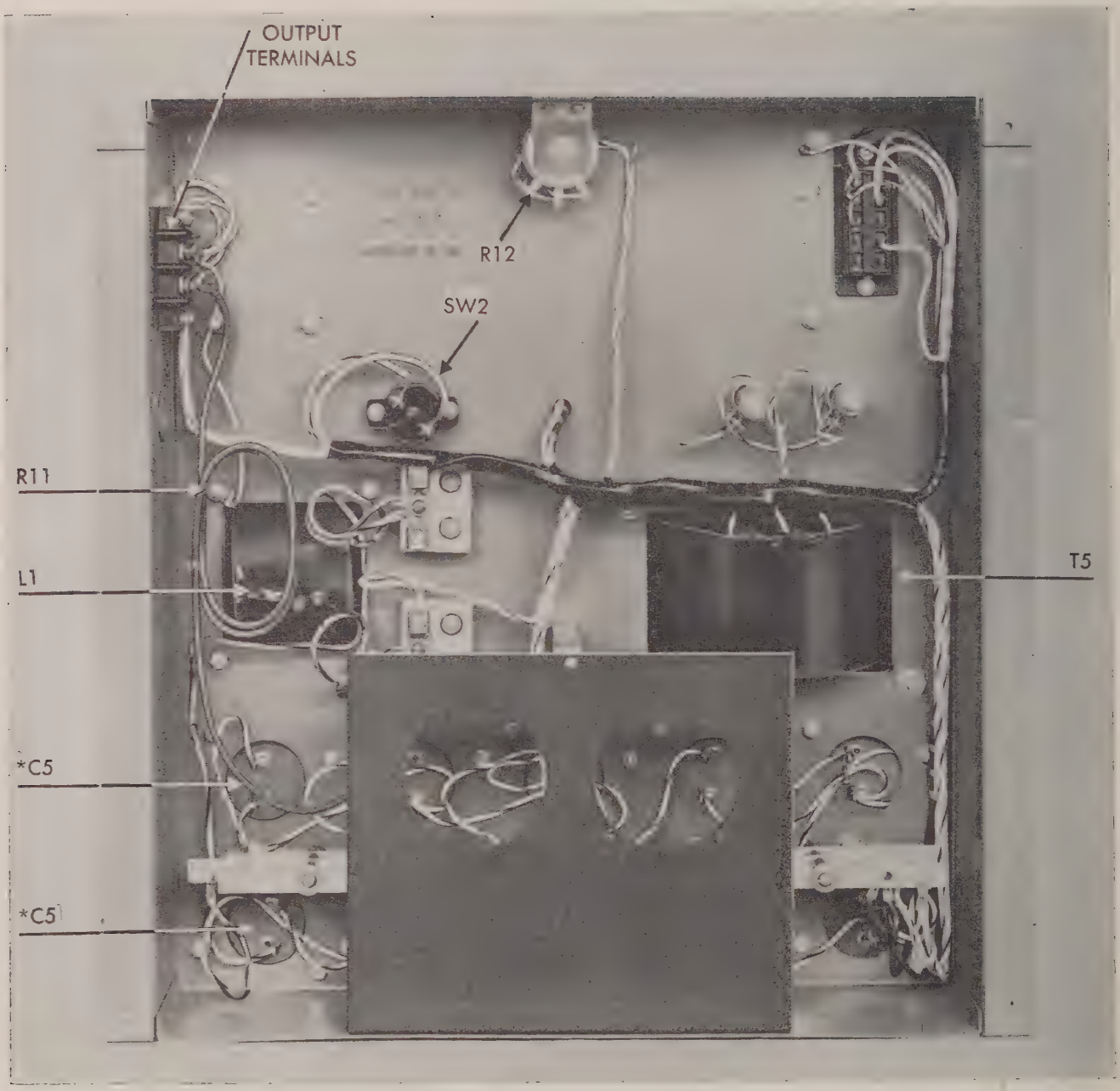
E-6-100A at Serial NH-915 (Top View)



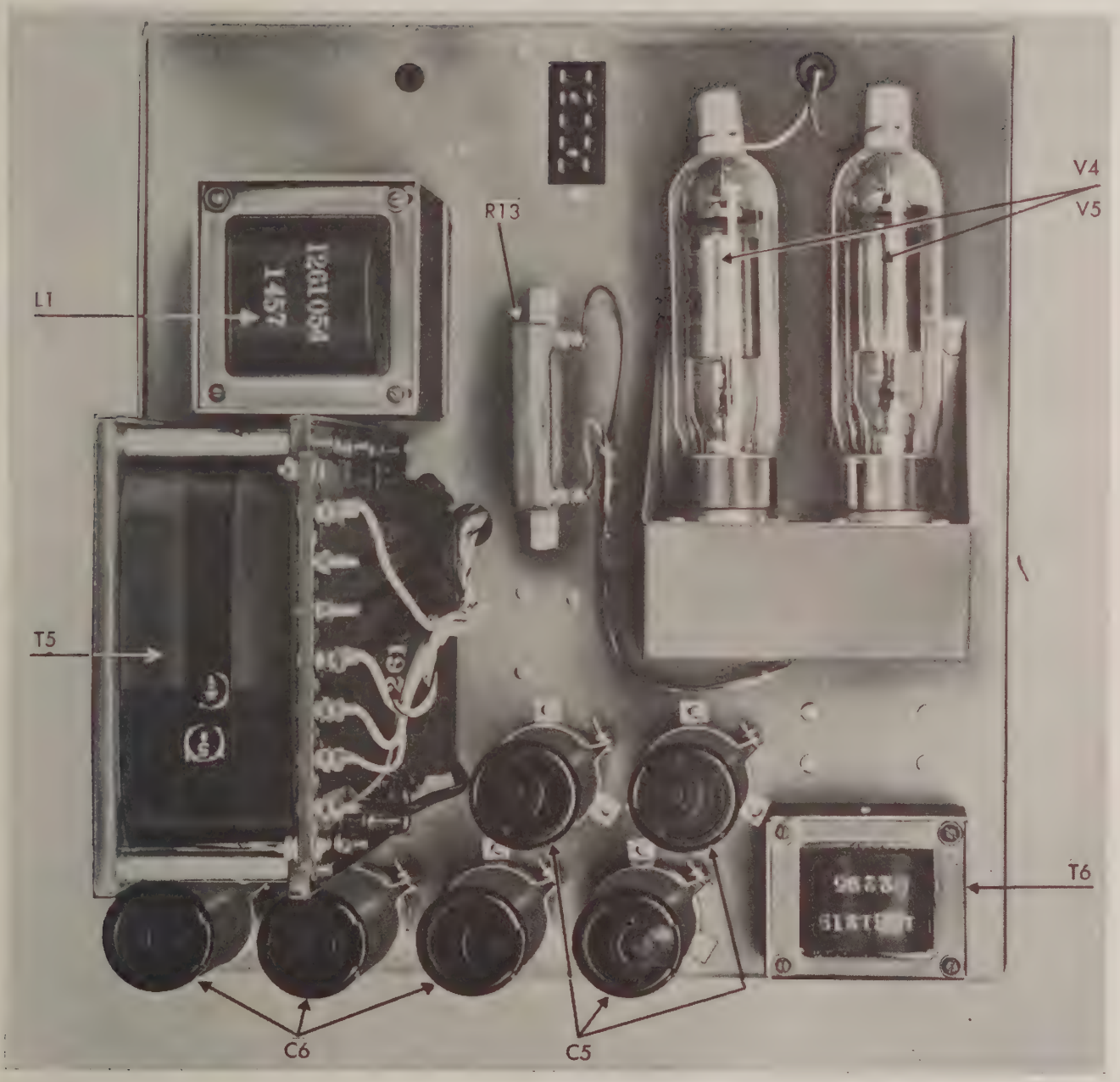
E-6-100A at Serial NH-915 (Bottom View)



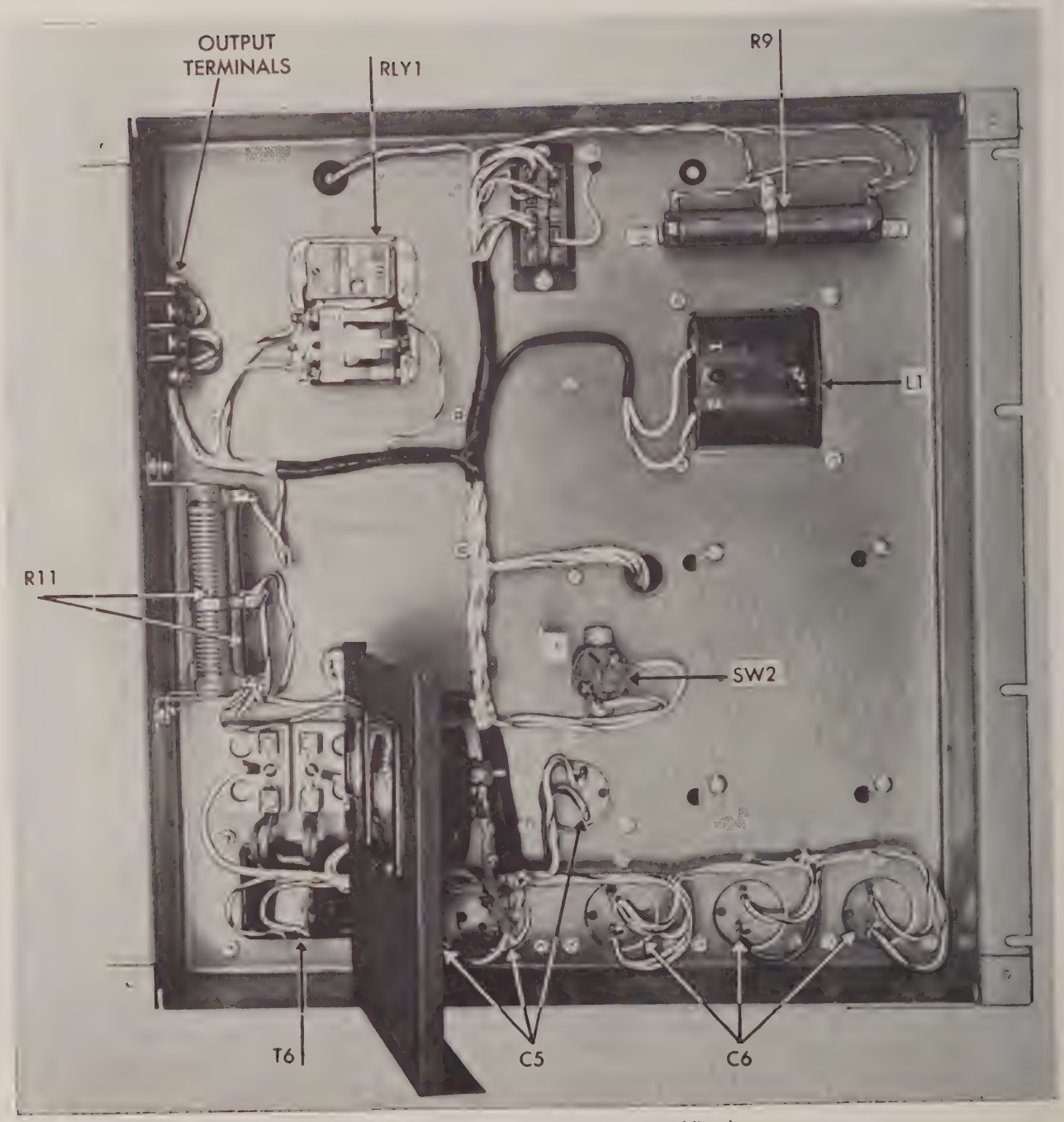
E-48-15 at Serial ND-356 (Top View)



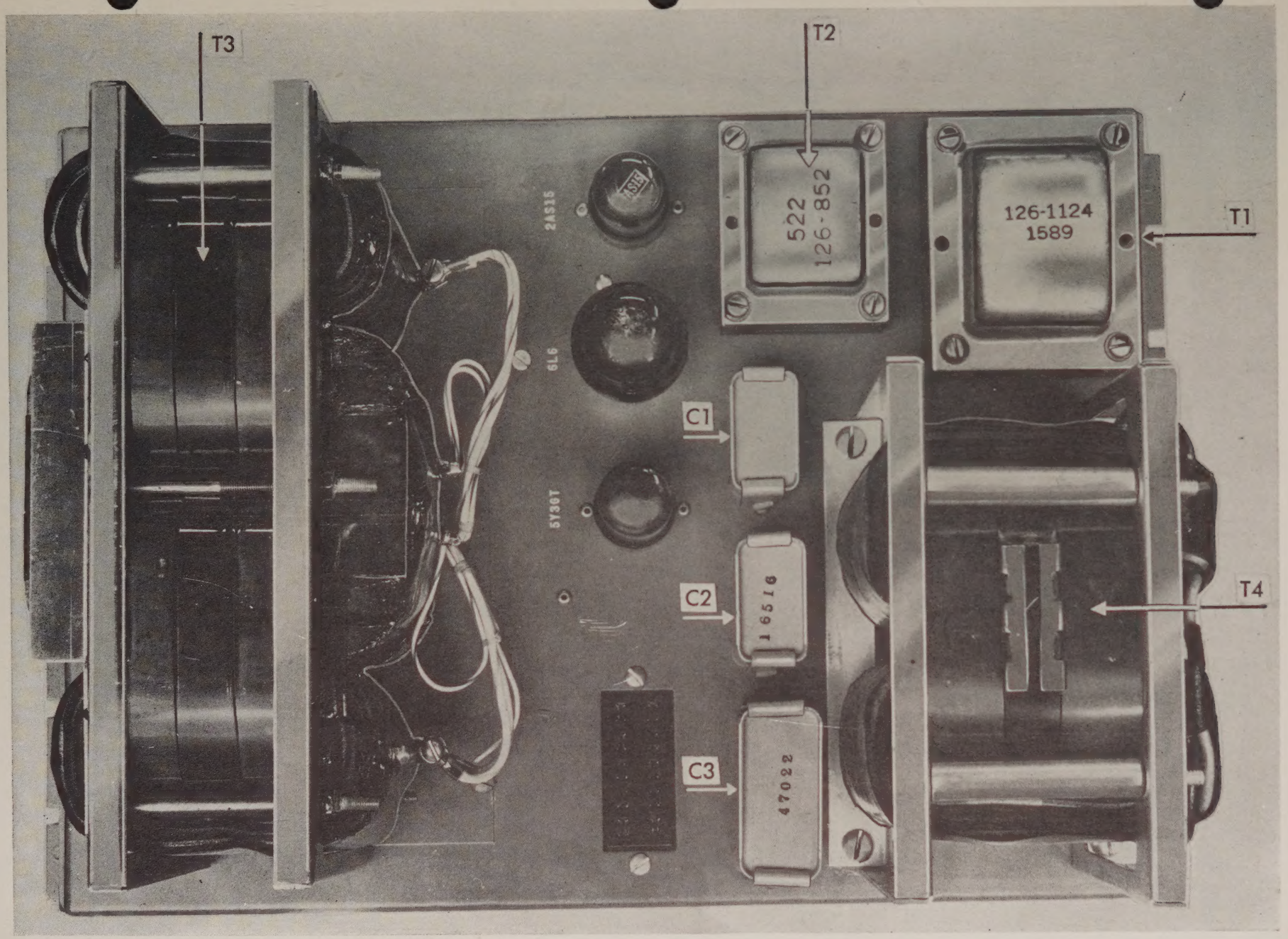
E-48-15 at Serial ND-356 (Bottom View)
*Refer to top view for arrangement of C5 and C6



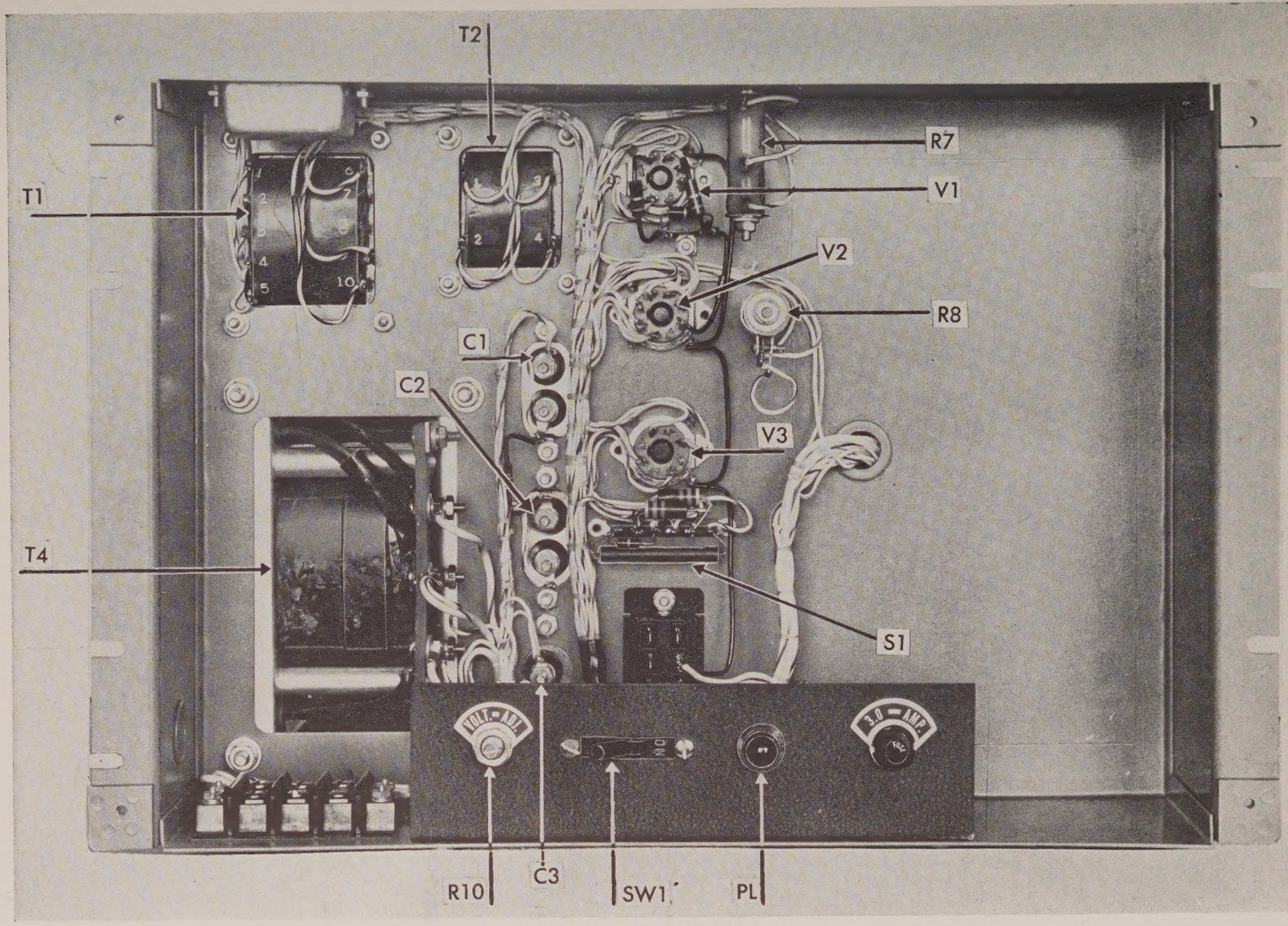
E-125-10 at Serial NR-573 (Top View)



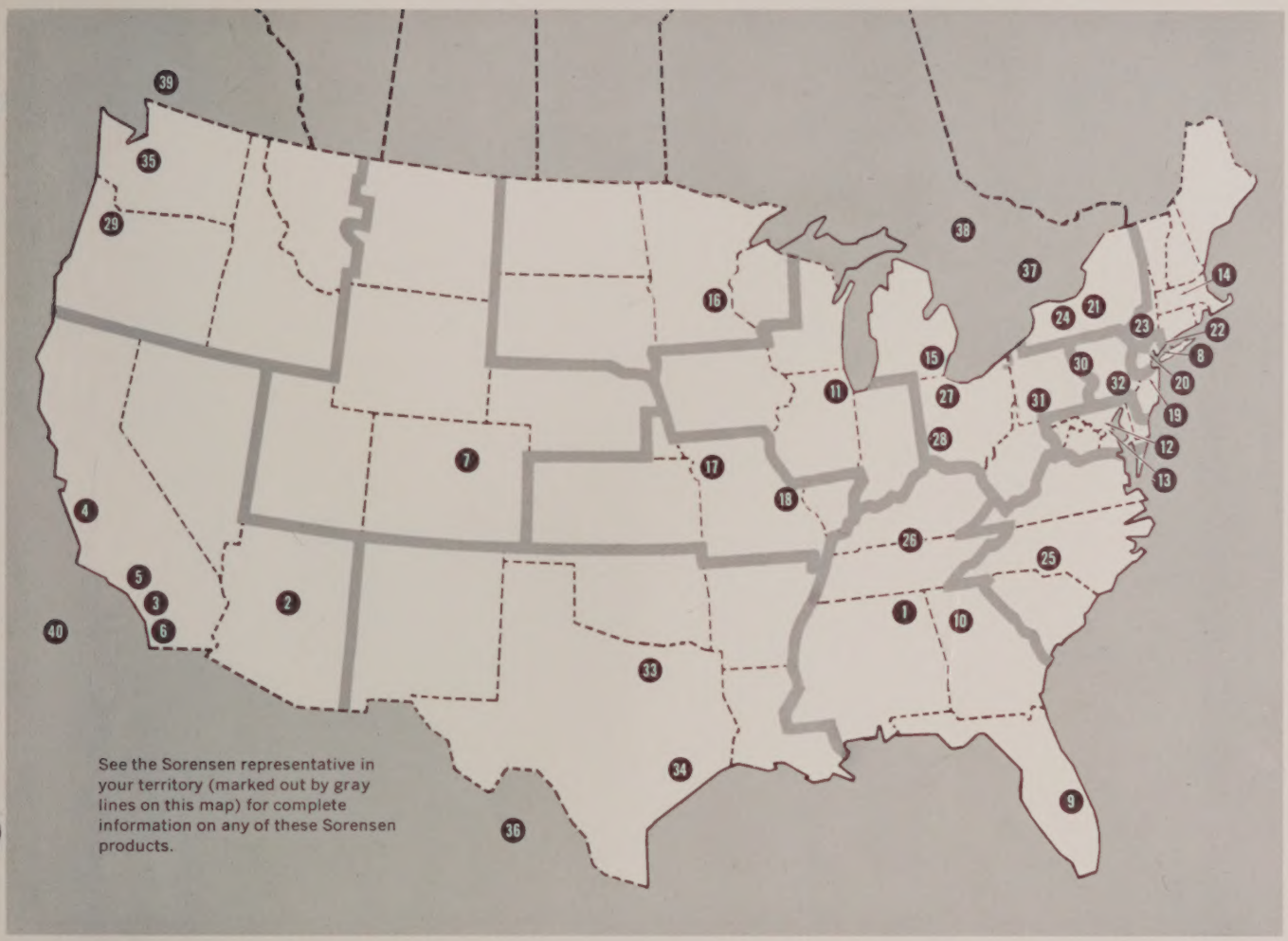
E-125-10 at Serial NR-573 (Bottom View)



2 KVA Controller (Top View)



2 KVA Controller (Bottom View)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